

REMARKS

This is intended as a full and complete response to the Office Action dated July 1, 2004, having a shortened statutory period for response set to expire on October 1, 2004. Please reconsider the claims pending in the application for reasons discussed below.

Claims 1, 4-24 and 74-109 remain pending in the application upon entry of this response. Claims 1, 4-24 and 74-109 stand rejected. Reconsideration of the rejected claims is requested for reasons presented below.

In the office action, claims 1 and 4-10 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication No. 20020068458A1 (*Chiang*), in view of U.S. Patent Publication No. 20020081855 (*Jiang*). The Examiner states that *Chiang* describes a method of thin film deposition for integrated circuit fabrication comprising providing a substrate and treating the substrate with a plasma prior to forming an organosilicate layer. The Examiner further states that *Jiang*, at least in paragraph 13, teaches that the H₂O₂ plasma chemistry is an equivalent plasma chemistry known in the art wherein the plasma is generated in a reaction chamber by applying an electric field to a gas mixture comprising molecular oxygen (O₂) and molecular hydrogen (H₂). The Examiner asserts that it would have been obvious for one of the ordinary skill in the art at the time of the invention to substitute *Jiang's* method of generating a plasma from H₂O₂ or H₂O for Applicant's method of generating a plasma from a gas mixture of H₂ and O₂ used to reduce or eliminate the resist poisoning. Applicant respectively traverses the rejection.

Chiang discloses a method to perform an in-situ clean/surface treatment to a surface prior to an ALD deposition. *Chiang* discloses the use of atomic hydrogen or halogen-containing radicals to react with the surface contaminants, such as oxides, to form oxygen containing byproducts, which are then easily pumped away (paragraph 25). *Jiang* discloses the use of an oxygen (O₂) plasma to reduce or eliminate the poisoning of resist. *Jiang* further discloses alternative plasma chemistries may be used, such as H₂, H₂O, H₂O₂, O₃, CO, CO₂, SO₂, etc. with or without gas additive like Ar or He (paragraph 13). *Jiang* does not teach that generating a plasma from H₂O₂ or H₂O is an

equivalent plasma known in the art to generating plasma from a gas mixture comprising molecular oxygen (O_2) and molecular hydrogen (H_2). *Jiang* teaches forming a plasma by the use of O_2 , O_3 , H_2 , H_2O_2 or H_2O amongst others and never in combination.

In the Advisory Action, the Examiner asserts “generating plasma from H_2O_2 or H_2O is equivalent to generating plasma from a gas mixture comprising molecular oxygen and molecular hydrogen.” According to the Declaration under 37 C.F.R. § 1.132, submitted on April 30, 2004, by Li-Qun Xia, a person skilled in the art would realize generating a plasma from H_2O_2 or H_2O is not equivalent to generating plasma from a gas mixture comprising molecular oxygen and molecular hydrogen. The Xia Declaration further states that a person skilled in the art would realize when plasma is applied to H_2O_2 , the disassociation products will be hydroxyl radicals (OH) and hydrogen radicals (H), not molecular oxygen (O_2) and molecular hydrogen (H_2).

In the present office action, the Examiner states “In fact the complete list of disassociated molecules would include the following: hydroxyl radicals (OH) and hydrogen radicals (H) and oxygen radicals (O).” Further, in the present office action, the Examiner states “It is further well known that H_2O_2 or H_2O when subjected to plasma will disassociate ultimately into hydroxyl radical (OH), molecular hydrogen (H_2) and also molecular (O) as shown below.” Applicant respectfully traverses the unsupported finding of fact.

The Examiner theorizes and attempts to stoichiometrically balance dissociation half reactions products of H_2O_2 plasma to prove existence of a molar equivalent of atomic oxygen (O) that may form molecular oxygen (O_2). Furthermore, the Examiner supports his mathematical exercise on the basis that the declaration of Li-Qun Xia does not mention disassociation of H_2O .

The Examiner errs in failing to recognize that hydrogen peroxide, as used in semiconductor processes, always contains water such that the aqueous solution usually contains no more than 30 wt% of H_2O_2 and typically about 10 wt% or less of H_2O_2 with the remainder of the solution being H_2O . Each H_2O_2 disassociates to form two equivalents of hydroxyl radicals (OH) while each H_2O disassociates to form one equivalent of hydroxyl radicals (OH) and one equivalent of hydrogen radicals (H). Therefore, the Xia Declaration is complete and stoichiometrically accurate in stating that

hydrogen peroxide disassociates into hydroxyl radicals (OH) and hydrogen radicals (H) since the Xia Declaration does not indicate the relative stoichiometric amounts of the hydroxyl radicals (OH) and the hydrogen radicals (H) in the absence of any information regarding the hydrogen peroxide content. The Examiner errs in negating the declaration and must accept the stated facts.

Therefore, *Chiang* and *Jiang*, alone or in combination, do not teach, show or suggest a method of thin film deposition for integrated circuit fabrication comprising providing a substrate, treating the substrate with a plasma prior to forming a organosilicate layer, wherein the plasma is generated in a reaction chamber by applying an electric field to a gas mixture comprising molecular oxygen (O₂) and molecular hydrogen (H₂) forming the organosilicate layer on the substrate and treating the organosilicate layer with the plasma, as recited in claim 1, and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Claims 11-24 and 74-109 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Chiang* and *Jiang*, as applied to claims 1, 4-10 above, further in view of U.S. Patent Publication No. 20020142579A1 (*Vincent*). The Examiner states *Chiang* and *Jiang* do not describe, yet *Vincent* does describe that the second gas mixture comprises a silicon source, a carbon source and an oxygen source and applying an electric field to that second gas mixture in the deposition chamber forms the carbon-containing silicate layer on the substrate. The Examiner asserts that it would have been obvious to one of ordinary skill in the art at the time of the invention to include *Vincent*'s steps of the second gas mixture with the process derived by combining *Chiang* and *Jiang* as discussed above. Applicant respectfully traverses the rejection.

Vincent discloses forming low dielectric constant interlayer materials by use of organosilicon precursors. The combined references do not suggest applying an electric field to a mixture of molecular oxygen (O₂) and molecular hydrogen (H₂) since *Vincent* adds nothing to the other references which are discussed above. Therefore, *Vincent*, *Chiang* and *Jiang*, alone or in combination, do not teach, show or suggest a method of thin film deposition of an organosilicate layer comprising positioning a substrate in a deposition chamber, providing a gas mixture to the deposition chamber, wherein the gas mixture comprises a silicon source, a carbon source and an oxygen source,

applying an electric field to the gas mixture in the deposition chamber to form the organosilicate layer on the substrate and treating the organosilicate layer with a plasma, wherein the plasma is generated by applying a second electric field to a second gas mixture comprising molecular oxygen gas and molecular hydrogen gas, as recited in claim 74, and claims dependent thereon. Withdrawal of the rejection is respectfully requested. Also, *Vincent, Chiang and Jiang*, alone or in combination, do not teach, show or suggest a method of thin film deposition of an organosilicate layer comprising positioning a substrate in a deposition chamber, depositing the organosilicate layer from a gas mixture, wherein the gas mixture comprises a silicon source, a carbon source and an oxygen source and treating the organosilicate layer with a plasma, wherein the plasma is generated by applying an electric field to a second gas mixture comprising molecular oxygen gas and molecular hydrogen gas, as recited in claim 96, and claims dependent thereon. Applicant further traverses the rejection of dependent claims 11-24 on the grounds stated above. Withdrawal of the rejection is respectfully requested.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show or suggest the invention as claimed.

Having addressed all issues set out in the office action, Applicant respectfully submits that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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